AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (Currently Amended) A semiconductor optical amplifier [[,]] formed from a vertical arrangement of substantially parallel material layers, the semiconductor optical amplifier amplifying an optical signal while confining it to an optical signal path substantially parallel to the material layers, the semiconductor optical amplifier comprising:

a signal waveguide including a signal guiding layer, said signal waveguide vertically confining the optical signal around said signal guiding layer; and

a laser cavity including an active layer, said laser cavity and said optical signal path vertically coinciding at an evanescent coupling region, said active layer and ~~being separate from~~ said signal guiding layer being vertically separated in said evanescent coupling region by at least one intervening layer;

wherein said active layer is positioned sufficiently near said signal guiding layer along said evanescent coupling region for an optical signal propagating along said signal guiding layer to be amplified by an evanescent coupling effect with said active layer.

2. (Original) The semiconductor optical amplifier of claim 1, wherein said signal guiding layer is a passive layer.

3. (Original) The semiconductor optical amplifier of claim 2, said signal waveguide comprising an input facet for receiving the optical signal and an output facet for outputting an amplified version of the optical signal, said input and output facets each being processed for antireflective transmission, said laser cavity further

comprising two end facets, said end facets each having a reflectivity of not less than 10%, said end facets facilitating lasing action in said laser cavity when pumped with an excitation current greater than a threshold current.

4. (Currently Amended) The semiconductor optical amplifier of claim 3, said input and output facets being disposed at longitudinally opposing ends of the semiconductor optical amplifier, said signal waveguide guiding the optical signal along an optical signal path between said input and output facets, wherein said active layer of said laser cavity is separated from said signal guiding layer of said signal waveguide by not less than 0.1 μm and not more than 2.0 μm along said evanescent coupling region ~~a first interval of the optical signal path in which said optical amplification occurs~~.

5. (Original) The semiconductor optical amplifier of claim 4, wherein a lasing direction of said laser cavity is transverse to the optical signal path along said first interval thereof.

6. (Original) The semiconductor optical amplifier of claim 4, wherein a lasing direction of said laser cavity is substantially parallel to the optical signal path along said first interval thereof.

7. (Original) The semiconductor optical amplifier of claim 6, said laser cavity end facets also being disposed at said longitudinally opposing ends of the semiconductor optical amplifier, said laser cavity emitting unused laser light from said end facets when pumped with said excitation current greater than said threshold current, wherein said laser cavity is laterally separated from the optical signal path near said longitudinally opposing ends by an amount sufficient to inhibit introduction of the unused laser light into external devices to which the signal waveguide is coupled.

8. (Original) The semiconductor optical amplifier of claim 7, wherein said optical signal path extends in a substantially straight direction from the input facet to the output facet, and wherein said laser cavity follows a crooked path near its end facets to achieve said lateral separation from the optical signal path.

9. (Original) The semiconductor optical amplifier of claim 8, said active layer having a gain characteristic extending over a first wavelength range, said optical signal comprising wavelengths in a second wavelength range, and said laser cavity having a lasing wavelength in a third wavelength range, wherein said second wavelength range lies entirely within said first wavelength range, and wherein said third wavelength range is a subset of said first wavelength range that is non-overlapping with said second wavelength range.

10. (Original) The semiconductor optical amplifier of claim 9, wherein said active layer comprises an InGaAsP/InGaAs/InP material system, wherein said first wavelength range lies between 1510-1580 nm, wherein said second wavelength range lies between 1530-1570 nm, and wherein said third wavelength range lies between 1510-1520 nm.

11-50 (canceled)

51. (Original) A semiconductor optical amplifier (SOA) formed from a vertical arrangement of substantially parallel material layers, the SOA guiding an optical signal along an optical signal path while amplifying the optical signal therealong, the SOA comprising:

an input facet for receiving the optical signal;

an output facet for outputting an amplified version of the optical signal;

a signal waveguide including a signal guiding layer, the signal waveguide extending in a first direction between said input facet and said output facet and defining the optical signal path therebetween; and

a transverse laser cavity oriented in a second direction transverse to said first direction, said transverse laser cavity and said signal waveguide defining a signal amplification region at locations of vertical coincidence therebetween, said transverse laser cavity being integrated with said signal waveguide into the vertical arrangement of substantially parallel material layers such that said optical signal is amplified in said signal amplification region using energy provided by said transverse laser cavity;

wherein said transverse laser cavity is segmented into a plurality of electrically isolated segments including a main segment that includes said signal amplification region and at least one auxiliary segment that does not include said signal amplification region, and wherein said main segment and said auxiliary segment are supplied with separately adjustable bias currents.

52. (Original) The SOA of claim 51, said signal guiding layer comprising a passive waveguiding material, said transverse laser cavity including an active layer vertically separated from said signal guiding layer in said signal amplification region by at least one intervening layer, said vertical separation being sufficiently small for an optical signal propagating along said signal guiding layer to be amplified in said signal amplification region by an evanescent coupling effect with said active layer.

53. (Original) The SOA of claim 51, said signal guiding layer comprising a gain medium, said transverse laser cavity including an active layer coextensive with said gain medium of said signal guiding layer in said signal amplification region, said optical signal being amplified in said signal amplification region by operation of a population inversion established in said gain medium by said transverse laser cavity.

54. (Original) The SOA of claim 51, wherein lasing action is achieved in said transverse laser cavity when said main segment bias current exceeds a main segment threshold, the optical signal experiencing gain-clamped amplification in said signal amplification region when said lasing action is achieved.

55. (Original) The SOA of claim 54, wherein the gain-clamped amplification of said optical signal is by a gain factor that does not vary substantially as said main segment bias current is further increased past said main segment threshold, said gain factor being positively and monotonically related to said main segment threshold.

56. (Original) The SOA of claim 55, said gain factor being dynamically adjustable through variation of said auxiliary segment bias current, said gain factor increasing as said auxiliary segment bias current is decreased, said gain factor decreasing as said auxiliary segment bias current is increased.

57. (Original) The SOA of claim 51, wherein said transverse laser cavity comprises a periodic grating structure for discouraging extraneous modes therein.

58. (Original) The SOA of claim 51, said transverse laser cavity having a nominal lasing wavelength, said optical signal having a nominal signal wavelength, said transverse laser cavity comprising an active layer extending through each of said main segment and said auxiliary segment and having identical material properties in both, wherein said active layer has a first gain vs. wavelength characteristic that peaks near said nominal lasing wavelength when operating at a first junction temperature, and wherein said active layer has a second gain vs. wavelength characteristic that peaks near said nominal signal wavelength when operating at a second junction temperature different than said first junction temperature.

59. (Original) The SOA of claim 58, wherein said active layer in said auxiliary segment operates at said first junction temperature and said active layer in said main segment operates at said second junction temperature when said auxiliary segment and said main segment are provided with first and second bias currents, respectively.

60. (Original) The SOA of claim 51, said transverse laser cavity having a nominal lasing wavelength, said optical signal having a nominal signal wavelength, said main segment comprising a first active layer, said auxiliary segment comprising a second active layer having different material characteristics than said first active layer, wherein said first active layer has a first gain vs. wavelength characteristic that peaks near said nominal signal wavelength, and wherein said second active layer has a second gain vs. wavelength characteristic that peaks near said nominal lasing wavelength.

61-70 (canceled)

71. (Original) A semiconductor optical amplifier, comprising:

a signal waveguide including a signal guiding layer, said signal waveguide defining an optical signal path between an input and an output; and

a plurality of laser cavities, each laser cavity including an active layer, each laser cavity being disposed between two end mirrors and defining a lasing path therebetween, said lasing paths being non-overlapping with each other, each lasing path vertically coinciding with said optical signal path at a distinct evanescent coupling region within which said active layer and said signal guiding layer are vertically separated by at least one intervening layer;

wherein, for each of said plurality of laser cavities, said vertical separation between said active layer and said signal guiding layer in said evanescent coupling region is sufficiently small for an optical signal propagating along said signal guiding layer to be amplified by an evanescent coupling effect with said active layer.

72. (Original) The semiconductor optical amplifier of claim 71, said semiconductor optical amplifier being formed from a vertical arrangement of substantially parallel material layers into which said signal waveguide and said plurality of laser cavities are integrated, said optical signal path longitudinally extending from a first edge to a second edge of said semiconductor optical amplifier,

wherein said lasing path of each laser cavity is transverse to said optical signal path in its associated evanescent coupling region.

73. (Original) The semiconductor optical amplifier of claim 72, wherein said end mirrors of said laser cavities are disposed along said first and second edges, respectively, each lasing path following an S-like trajectory between said end mirrors.

74. (Original) The semiconductor optical amplifier of claim 72, wherein said end mirrors of said laser cavities are disposed along third and fourth edges of said semiconductor optical amplifier substantially perpendicular to said first and second edges, respectively, each lasing path following a straight-line trajectory between said end mirrors.

75. (Original) The semiconductor optical amplifier of claim 71, said semiconductor optical amplifier being formed from a vertical arrangement of substantially parallel material layers into which said signal waveguide and said plurality of laser cavities are integrated, said optical signal path longitudinally extending from a first edge to a second edge of said semiconductor optical amplifier, wherein said lasing path of each laser cavity is substantially parallel to said optical signal path in its associated evanescent coupling region.

76. (Original) The semiconductor optical amplifier of claim 75, wherein said end mirrors of said laser cavities are disposed along third and fourth edges of said semiconductor optical amplifier substantially perpendicular to said first and second edges, respectively, each lasing path following an S-like trajectory between said end mirrors.

77. (Original) The semiconductor optical amplifier of claim 75, wherein said end mirrors of said laser cavities are disposed along said first and second edges,

respectively, each lasing path following an S-like trajectory between said end mirrors.

78. (Original) The semiconductor optical amplifier of claim 71, wherein said plurality of laser cavities are electrically isolated from each other and are supplied with separate bias currents, and wherein gain-clamped amplification of the optical signal is achieved in the evanescent coupling region of each laser cavity when lasing action is achieved therein.

79. (Original) The semiconductor optical amplifier of claim 78, wherein for each of said laser cavities said lasing action is achieved when said bias current exceeds a lasing threshold current, said gain-clamped amplification of said optical signal being by a gain factor that does not vary substantially as said bias current is further increased past said lasing threshold current.

80. (Original) The semiconductor optical amplifier of claim 79, said optical signal path longitudinally extending from a first edge to a second edge of said semiconductor optical amplifier, each of said bias currents resulting in a bias current density within its respective laser cavity, each of said laser cavities achieving said lasing action when provided with a bias current density greater than a lasing threshold current density corresponding to said lasing threshold current, said gain factor increasing with increased lasing threshold current density, said gain factor increasing with increased amplification distance, said amplification distance corresponding to a longitudinal extent of said evanescent coupling region along said optical signal path.

81. (Original) The semiconductor optical amplifier of claim 80, said plurality of laser cavities having identical lateral dimensions and identical gain factors.

82. (Original) The semiconductor optical amplifier of claim 80, said plurality of

laser cavities having different gain factors by virtue of differences thereamong in one or more items selected from the group consisting of: amplification distance, end mirror reflectivity, and gain medium composition.

83. (Original) The semiconductor optical amplifier of claim 71, said plurality of laser cavities being electrically isolated from each other, each laser cavity being segmented into a plurality of electrically isolated segments including a main segment that includes said evanescent coupling region and at least one auxiliary segment that does not include said evanescent coupling region, said main segment and said auxiliary segment being supplied with separately adjustable bias currents, said bias currents also being separately adjustable across said plurality of laser cavities.

84. (Original) The semiconductor optical amplifier of claim 83, wherein for each laser cavity, for a fixed auxiliary segment bias current, lasing action is achieved when said main segment bias current exceeds a main segment threshold, said optical signal experiencing gain-clamped amplification in said evanescent coupling region by a gain factor that does not vary substantially as the main segment bias current is further increased past said main segment threshold, said gain factor being positively and monotonically related to said main segment threshold.

85. (Original) The semiconductor optical amplifier of claim 84, said gain factor being dynamically adjustable in each of said laser cavities through variation of said auxiliary segment bias current, said gain factor increasing as said auxiliary segment bias current is decreased, said gain factor decreasing as said auxiliary segment bias current is increased.

86. (Original) The semiconductor optical amplifier of claim 71, each of said plurality of laser cavities having a different lasing wavelength.

87. (Original) The semiconductor optical amplifier of claim 71, said

semiconductor optical amplifier containing N laser cavities sequentially disposed along said optical signal path, wherein all even numbered laser cavities have an operating wavelength λ_1 and all odd numbered laser cavities have a different operating wavelength λ_2.

88. (Original) The semiconductor optical amplifier of claim 71, said semiconductor optical amplifier comprising N such laser cavities sequentially disposed along said optical signal path, said N laser cavities operating at M different wavelengths $\lambda_1, \ldots, \lambda_M$, $2 \leq M \leq N$, wherein the i^{th} laser cavity has an operating wavelength of $\lambda_{(i \bmod M)}$.

89. (Original) The semiconductor optical amplifier of claim 88, wherein each of said N laser cavities comprises a periodic grating structure consistent with its respective operating wavelength.

90. (Original) The semiconductor optical amplifier of claim 89, each of said N laser cavities having a lasing path substantially perpendicular to said optical signal path in said evanescent coupling regions, wherein said periodic grating structure are distributed feedback (DFB) gratings that extend into said evanescent coupling regions.

91-100. (Canceled)

101. (Original) A semiconductor optical amplifier (SOA) formed from a vertical arrangement of substantially parallel material layers, the SOA guiding an optical signal along an optical signal path while amplifying the optical signal therealong, the SOA comprising:

an input facet for receiving the optical signal;

an output facet for outputting an amplified version of the optical signal;

a signal waveguide including a signal guiding layer, the signal waveguide

extending between said input facet and said output facet and defining the optical signal path therebetween; and

a plurality of transverse laser cavities, each transverse laser cavity being disposed between two end mirrors and defining a lasing path therebetween, each transverse laser cavity being electrically isolated from the others, said lasing paths being non-overlapping with each other, each lasing path vertically coinciding with said optical signal path at a distinct signal amplification region, each of said transverse laser cavities being integrated with said signal waveguide into the vertical arrangement of substantially parallel material layers such that said optical signal is amplified in each signal amplification region using energy provided by each respective transverse laser cavity;

wherein each transverse laser cavity is segmented into a plurality of electrically isolated segments including a main segment that includes said signal amplification region and at least one auxiliary segment that does not include said signal amplification region, wherein said main segment and said auxiliary segment are supplied with separately adjustable bias currents.

102. (Original) The SOA of claim 101, said signal guiding layer comprising a passive waveguiding material, each of said transverse laser cavities including an active layer vertically separated from said signal guiding layer in its respective signal amplification region by at least one intervening layer, said vertical separation being sufficiently small such that the optical signal propagating along said signal guiding layer is amplified in said signal amplification region by an evanescent coupling effect with said active layer.

103. (Original) The SOA of claim 101, said signal guiding layer comprising a gain medium, each of said transverse laser cavities including an active layer coextensive with said gain medium of said signal guiding layer in said signal amplification region, said optical signal being amplified in said signal amplification region by operation of a population inversion established in said gain medium by said

transverse laser cavity.

104. (Original) The SOA of claim 101, a first of said transverse laser cavities having its signal amplification region closer to said input facet, a second of said transverse laser cavities having its signal amplification region closer to said output facet, the active layers of said first and second transverse lasers comprising substantially similar materials, each of said separately adjustable bias currents resulting in a bias current density within its respective transverse laser cavity segment, wherein lasing action is achieved in each transverse laser cavity when its main segment bias current density exceeds a main segment current density threshold, the optical signal experiencing gain-clamped amplification in the associated signal amplification region when said lasing action is achieved.

105. (Original) The SOA of claim 104, wherein the gain-clamped amplification of said optical signal is by a gain factor that does not vary substantially as said main segment bias current density is further increased past said main segment current density threshold, said gain factor being positively and monotonically related to said main segment current density threshold.

106. (Original) The SOA of claim 105, said main segment current density threshold and said gain factor being dynamically adjustable through variation of said auxiliary segment bias current density, said main segment current density threshold and said gain factor each increasing as said auxiliary segment bias current density is decreased, said main segment current density threshold and said gain factor each decreasing as said auxiliary segment bias current density is increased.

107. (Original) The SOA of claim 106, wherein a signal-to-noise ratio in said amplified version of said optical signal is dynamically adjustable through dynamic adjustments of said main and auxiliary segment bias current densities in said first and second transverse laser cavities while an overall optical signal gain stays the

same.

108. (Original) The SOA of claim 107, said first transverse laser cavity having a quiescent main segment bias current density of $J1_M$(old) and a quiescent auxiliary segment bias current density of $J1_A$(old) yielding a quiescent signal gain of g1(old) in its signal amplification region, said second transverse laser cavity having a quiescent main segment bias current density of $J2_M$(old) and a quiescent auxiliary segment bias current density of $J2_A$(old) yielding a quiescent signal gain of g2(old) in its signal amplification region, wherein said active layers of said first and second transverse lasers possess a sublinear relationship between percent spontaneous emission noise change and percent signal gain change such that when quiescent operation points are changed to $J1_A(new) < J1_A(old)$, $J1_M(new) > J1_M(old)$, $g1(new) > g1(old)$, $J2_A(new) > J2_A(old)$, $J2_M(new) < J2_M(old)$, $g2(new) < g2(old)$, with $g1(new)g2(new) = g1(old)g2(old)$, the amount of amplified spontaneous emission noise in said amplified version of said optical signal is reduced.

109. (Original) The SOA of claim 107, said first transverse laser cavity having a quiescent main segment bias current density of $J1_M$(old) and a quiescent auxiliary segment bias current density of $J1_A$(old) yielding a quiescent signal gain of g1(old) in its signal amplification region, said second transverse laser cavity having a quiescent main segment bias current density of $J2_M$(old) and a quiescent auxiliary segment bias current density of $J2_A$(old) yielding a quiescent signal gain of g2(old) in its signal amplification region, wherein said active layers of said first and second transverse lasers possess a superlinear relationship between percent spontaneous emission noise change and percent signal gain change such that when quiescent operation points are changed to $J1_A(new) > J1_A(old)$, $J1_M(new) < J1_M(old)$, $g1(new) < g1(old)$, $J2_A(new) < J2_A(old)$, $J2_M(new) > J2_M(old)$, $g2(new) > g2(old)$, with $g1(new)g2(new) = g1(old)g2(old)$, the amount of amplified spontaneous emission noise in said amplified version of said optical signal is reduced.

110. (Original) The SOA of claim 101, wherein the lasing path of each of said transverse laser cavities is substantially parallel to the optical signal path in its respective signal amplification region.

111-160. (canceled)